

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., and
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioner

v.

ZOPHONOS INC.,
Patent Owner

Case IPR2026-00085
U.S. Patent No. 11,900,016

**DECLARATION OF JUSTIN D. MATHEW, PH.D.,
IN SUPPORT OF PATENT OWNER'S PRELIMINARY RESPONSE**

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Zophonos EX2004
Samsung v. Zophonos
IPR2026-00085

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I, Justin D. Mathew, hereby declare as follows.

I. INTRODUCTION

1. I have been retained as an expert witness on behalf of Patent Owner Zophonos Inc. (“Patent Owner”) for the above-captioned *inter partes* review (“IPR”). I am being compensated for my time in connection with this IPR at my normal hourly rate. My compensation is not contingent on either my expert opinion or the outcome of this litigation. I have no other interest in this proceeding.

2. I understand that this Declaration accompanies Patent Owner’s Preliminary Response filed in this IPR involving U.S. Patent No. 11,900,016 (“the ’016 patent”) (EX1001), which resulted from U.S. Application No. 17/555,813 (“the ’813 application”), filed December 20, 2021. The ’813 application claims priority as a continuation application to U.S. Application No. 16/656,259, filed October 17, 2019, which is a continuation of U.S. Application No. 16/421,141, filed May 23, 2019, which is a continuation-in-part of U.S. Application No. 16/155,919, filed October 10, 2018, which is a continuation of U.S. Application No. 14/862,304, filed September 23, 2015, which claims priority to U.S. Provisional Application No. 62/054,286 filed September 23, 2014. My opinions regarding the knowledge in the art at the time of the ’016 patent are based on the September 23, 2014, priority date.

3. In preparing this Declaration, I have reviewed the ’016 patent and

each of the documents cited herein, in light of general knowledge in the art before the '016 patent's priority date. In formulating my opinions, I have relied upon my experience, education, and knowledge in the relevant art. In formulating my opinions, I have also considered the viewpoint of a person of ordinary skill in the art ("POSITA") (as discussed further below in Section V) at the time of the '016 patent's priority date.

II. MY BACKGROUND AND QUALIFICATIONS

4. I received a Bachelor's degree in Electrical and Computer Engineering from the University of Rochester in 2010, a Master's Degree in Music Technology from New York University in 2012, and a Ph.D. in Computer Science from the University of Paris-Saclay in 2017.

5. From 2024 to the present, I have been a member of the faculty of North Carolina State University as an Associate Teaching Professor and the Director of Undergraduate Programs for Music Technology in the Department of Performing Arts and Technology. From 2024 to the present, I have been a member of the faculty of North Carolina State University as an Associate Teaching Professor and the Director of Undergraduate Programs for Music Technology in the Department of Performing Arts and Technology. In this role, I direct the academic offerings of the Music Technology major and the department as a whole. As part of my responsibilities, I teach courses in Acoustics & Psychoacoustics,

Audio Digital Signal Processing, Audio Plugin Development, Audio Embedded Software, and Senior Capstone courses. In addition, my research focuses on three areas - measuring performance technique of musicians, personalizing binaural rendering systems, and enhancing spatial dimensions of musical excitation methods. I've been awarded a North Carolina State University - Data Science Academy Seed Grant in 2024 on measuring performance techniques.

6. Prior to my tenure at North Carolina State University, I was a lecturer in Music Engineering from August 2022 to May 2024 for the University of Miami. I was also a staff engineering scientist for Nielsen from July 2022 to October 2024. At the University of Miami, I taught courses on digital audio signal processing and audio plugin development. At Nielsen, I worked in the research and development team working new methods to measure the audience viewership of live TV shows and streaming media. In particular, I worked on researching and developing Artificial Intelligence and Machine Learning models for embedded systems. Lastly, I was listed as an inventor on multiple patents.

7. Additionally, I was the Lead Audio Research and Development Engineering for Magic Leap from January 2018 to June 2022. In this role, I served as an R&D engineer with my main role to research and define requirements for Magic Leap customers and partners and develop prototypes and plans for productization of those features. Some of the projects included designing tools to

develop audio AI systems that can detect machinery defects through sound, a real-time spatial sound synthesis system for augmented reality applications, and automated speaker calibrations system in manufacturing. I was also listed as an inventor on a number of patents during this time.

8. I have authored numerous publications centered around audio signal processing. For instance, in 2025, I co-authored a publication for constructing a mixed-use studio designed to accommodate a versatile audio system. The publication provides a detailed account of how the space was transformed and the necessary audio and acoustical considerations needed to enhance the flexibility of the studio. I have also co-authored numerous other publications directed towards acoustical and audio processing research for immersive audio environments. I am a listed author on a number of patents directed towards audio processing technologies.

9. I understand that a copy of my complete *curriculum vitae* has been submitted as Exhibit 2005, which includes a list of my publications, and other details regarding my expertise and qualifications.

III. LIST OF DOCUMENTS CONSIDERED

10. I have considered the following documents listed below in addition to any other documents cited in this Declaration. To the best of my knowledge, these documents are true and accurate copies of what they purport to be. An expert in the

field would reasonably rely on them to formulate opinions such as those set forth in this Declaration.

Paper No.	Description
3	Petition for <i>Inter Partes</i> Review of U.S. Patent No. 11,900,016

Exhibit No.	Description
1001	U.S. Patent No. 11,900,016 (“the ’016 Patent”)
1002	Declaration of Chris Kyriakakis, Ph.D. (“Kyriakakis”)
1003	<i>Curriculum Vitae</i> of Chris Kyriakakis, Ph.D.
1004	File History of U.S. Patent No. 11,900,016 (“File History”)
1005	U.S. Patent Application Publication 2008/0137873 (“Goldstein873”)
1006	U.S. Patent Application Publication 2013/0316642 (“Newham”)
1007	U.S. Patent Application Publication 2007/0127734 (“Brulle”)
1008	U.S. Patent Application Publication 2009/0061837 (“Chaudhri”)
1009	U.S. Patent Application Publication 2014/0254842 (“Smith”)
1010	U.S. Patent 8,194,864 (“Goldstein864”)
1011	U.S. Patent Application Publication 2014/0126748 (“Usher”)
1012	U.S. Patent Application Publication 2015/0012826 (“Tengstrand”)
1013	U.S. Patent Application Publication 2013/0064385 (“Jeong”)
1016	Excerpts from Microsoft Computer Dictionary (5th ed. 2002) (“Computer Dictionary”)

Exhibit No.	Description
1017	Excerpts from Robert Oshana, “DSP Software Development Techniques Embedded and Real-Time Systems” (2006) (“Oshana”)
1018	Excerpts from Thomas D. Rossing, Richard F. Moore, and Paul A. Wheeler, “The Science of Sound” (3rd ed. 2002) (“Rossing”)
2006	<i>Sound Level Measurement, Monitoring, Management, and Documentation in Music Venues</i> , WORLD HEALTH ORG. (May 2020), accessed at https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/monograph-on-sound-level-measurement-management-and-documentation-in-music-venues.pdf?sfvrsn=69990849_5
2007	<i>BOSE Announces the QuietComfort 20 Headphones: The Most Versatile Bose Headphones Ever</i> , GSTYLE MAG. (JUNE 4, 2013) https://gstylemag.com/2013/06/04/bose-announces-the-quietcomfort-20-headphones-the-most-versatile-bose-headphones-ever .
2008	Saswati Sarkar, Farooq Unjum & Ratul Guha, <i>Optimal Communication in Bluetooth Piconets</i> , 54 IEEE TRANS’NS ON VEHICULAR TECH. 2 (March 2005), accessed at: https://repository.upenn.edu/bitstreams/2a1197f4-ff50-45ef-9060-fc05b302651b/download
2009	Andrew N. Rimell <i>et al.</i> , <i>Design of digital filters for frequency weightings (A and C) required for risk assessments of workers exposed to noise</i> , INDUSTRIAL HEALTH (Sept. 13, 2014) https://pmc.ncbi.nlm.nih.gov/articles/PMC4331191/pdf/indhealth-53-021.pdf
2010	Nick Hunn, <i>Introducing Bluetooth LE Audio</i> , (Jan. 2022) accessed at: https://www.bluetooth.com/wp-content/uploads/2022/01/Introducing-Bluetooth-LE-Audio-book.pdf
2011	Chucri A. Kardous, <i>Noise Dosimeters</i> , Nat’l Inst. For Occupational Safety and Health, (Oct. 2007), accessed at: https://stacks.cdc.gov/view/cdc/188701/cdc_188701_DS1.pdf

Exhibit No.	Description
2012	John R. Foster <i>et al.</i> , <i>Sound-level measurements and calculations of safe noise dosage during EPI at 3 T</i> , 12 J. MAGNETIC RESONANCE IMAGING 157 (Jul. 2000).
2013	Peter M. Rabinowitz, <i>Noise-Induced Hearing Loss</i> , AM. FAM. PHYSICIAN (May 1, 2000) https://www.aafp.org/pubs/afp/issues/2000/0501/p2749.html
2014	<i>Occupational Noise Exposure</i> , OSHA (last updated Dec. 12, 2008) https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.95
2015	Brian Fligor, <i>Recreational NIHL: A Summary of the Evidence</i> , AUDIOLOGY ONLINE, (October 31, 2011) https://www.audiologyonline.com/articles/recreational-nihl-summary-evidence-800
2016	Nikita Varshney & Sukhwinder Singh, <i>Embedded Speech Recognition System</i> , Int’l J. Adv. Rsch. In Electrical, Electronics, and Instrumentation Engineering, (April 2014), accessed at: https://www.rroij.com/open-access/embedded-speech-recognition-system.pdf
2017	<i>Soundhawk is a ‘smart hearing aid’ that cuts through annoying background noise to help you hear more clearly</i> , THE NEXT WEB (June 24, 2014), https://thenextweb.com/news/soundhawk-smart-hearing-aid-cuts-annoying-background-noise-help-hear-clearly
2018	Rabinowitz, et al., <i>The Dose Response Relationship between In Ear Occupational Noise Exposure and Hearing Loss</i> , Occup. Environ., (July 2013) https://pmc.ncbi.nlm.nih.gov/articles/PMC4075944/
2019	<i>Noise Exposure Computation</i> , OSHA (last updated Dec. 12, 2008) accessed at: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.95AppA
2020	Interim Processes Memo for PTAB Workload Management Memorandum (March 2025).

IV. LEGAL UNDERSTANDING

A. My Understanding of Claim Construction

11. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art at the time of the invention. I understand that claim terms are given their plain and ordinary meaning as would be understood by a person of ordinary skill in the relevant art (a “POSITA”) in the context of the patent’s specification and prosecution history. A claim term, however, will not receive its ordinary meaning if the patentee acted as his or her own lexicographer and clearly set forth a definition of the claim term in the specification. In this case, the claim term will receive the definition set forth in the patent.

B. My Understanding of Obviousness

12. I understand that a patent claim is invalid if the claimed invention would have been obvious to a person of ordinary skill in the art at the time the application was filed. I understand that this means that even if all of the requirements of the claim cannot be found in a single prior-art reference that would anticipate the claim, the claim can still be invalid.

13. To obtain a patent, a claimed invention must have been, as of its priority date, nonobvious in view of the prior art in the field. I understand that a patent claim is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have

been obvious at the time the invention was made to a person having ordinary skill in the art.

14. I understand that to prove that prior art or a combination of prior art renders a patent claim obvious, it is necessary to: (1) identify the particular references that, singly or in combination, render the patent claim obvious; (2) specifically identify which elements of the patent claim appear in each of the asserted references; and (3) explain how the prior art references could have been combined in order to create the inventions claimed in the patent claim.

15. I also understand that when considering the obviousness of a patent claim, one should consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

16. I understand that certain objective indicia can be important evidence as to whether a patent is obvious or nonobvious. Such indicia include: (1) commercial success of products covered by the patent claims; (2) a long-felt need for the invention; (3) failed attempts by others to make the invention; (4) copying of the invention by others in the field; (5) unexpected results achieved by the invention as compared to the closest prior art; (6) praise of the invention by the infringer or others in the field; (7) the taking of licenses under the patent by

others; (8) expressions of surprise by experts and those skilled in the art at the making of the invention; and (9) the patentee proceeded contrary to the accepted wisdom of the prior art.

17. I also understand that “obviousness” is a legal conclusion based on the underlying factual issues of the scope and content of the prior art, the differences between the claimed invention and the prior art, the level of ordinary skill in the pertinent art, and any objective indicia of non-obviousness. For that reason, I am not rendering a legal opinion on the ultimate legal question of obviousness. Rather, my testimony addresses the underlying facts and factual analysis that would support a legal conclusion of obviousness or non-obviousness, and when I use the term obvious, I am referring to the perspective of one of ordinary skill at the time of invention of the ’016 patent.

C. My Understanding of a Person Having Ordinary Skill in the Art

18. I understand that a POSITA is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

19. I understand that the following should be considered when deciding the level of ordinary skill in the art that someone would have had at the time the claimed invention was made:

- the levels of education and experience of persons working in the field;

- the types of problems encountered in the field; and
- the sophistication of the technology.

20. My opinion below explains how a POSITA would have understood the technology described in the documents I have identified herein around the time of the '016 patent.

21. Regardless of whether I use “I” or “POSITA” during my technical analysis below, all of my statements and opinions are always to be understood to be based on how a POSITA would have understood or read a document at the time of the '016 patent.

V. PERSON OF ORDINARY SKILL IN THE ART

22. For purposes of this Declaration, I have applied Dr. Kyriakakis's articulation of a POSITA. EX1002, ¶22. It is my opinion that the definition of a POSITA would not materially affect the limited analysis required for deciding institution and presented in this Declaration. If called to give further opinions in this proceeding should trial be instituted, I reserve the right to reconsider the definition of a POSITA and arrive at my own conclusion.

VI. OVERVIEW OF THE STATE OF THE ART

23. I understand that the '016 patent arises from the deficiencies among audio monitoring and manipulation systems implemented among a variety of audiological environments. EX1001, 1:19-25. The '016 patent describes how

“sound systems [were] designed to be used in a specific environment.” EX1001, 1:31-33. Audio quality and acoustic treatment, regardless of the environment, were typically controlled by a combination of human intervention, audio software, and hardware. EX1001, 1:43-47.

24. However, audio outputs within these systems could not be effectively managed due to “improper calibrations of signal propagation and signal degradation, as well as unwanted harmonics and soundwave reflections.” EX1001, 1:51-54; *see also* 1:55-57 (describing additional drawbacks of prior-existing systems). Accordingly, systems prior to the priority date of the ’016 patent could not appropriately manage and manipulate sound in a manner that produced clear, high-fidelity output while prioritizing the hearing health of listeners. EX1001, 5:50-56. Hearing health of audio listeners was a focal point for many jurisdictional entities at this point in time given the drawbacks of these systems. *See* EX2006, at 10-11 (discussing the introductions of various hearing health guidelines around the time of the ’016 patent’s priority date).

25. These issues are compounded in sound systems utilizing the devices existing by the priority date of the ’016 patent. EX1001, 2:24-37. Developments in the audio engineering field were “expected to shift a smart device's feature set, and how a smart device communicates with both the user (interface) and the network (including other smart devices).” EX1001, 10:64-11:2. As such, conventional

systems lacked the modularity needed to implement audio manipulation functionality across an ecosystem of devices. *See* EX1001, 11:7-13.

VII. OVERVIEW OF THE '016 PATENT

26. To address these numerous deficiencies, the '016 patent presents a novel and innovative technique for audio manipulation and sound management among a variety of computing devices. *See e.g.*, EX1001, 1:19-25; 4:66-27. The '016 patent describes “autonomously collect[ing] audio data via a series of integrated devices” and “adjust[ing] system outputs accordingly” such that sound is both intelligible to the user and protective of the user’s health. EX1001, 8:29-37; 9:19-56. These noise control functions may also include customizable user functions “to ensure that both the audio perceived by them, and the audio perceived by their device is in accordance with some predetermined parameters/settings.” EX1001, 8:37-41.

27. The '016 patent advances an innovative architecture that facilitates complex audio management and manipulation functionality across a variety of computing devices. This architecture, reproduced below, is wholly unique and enables a single computing device (or multiple computing devices) to both sense audio energy within a specific cluster of devices and adjust the output of connected output devices to ensure high quality, high fidelity, and nonhazardous output. *E.g.*, EX1001, 17:45-53; 17:62-18:3.

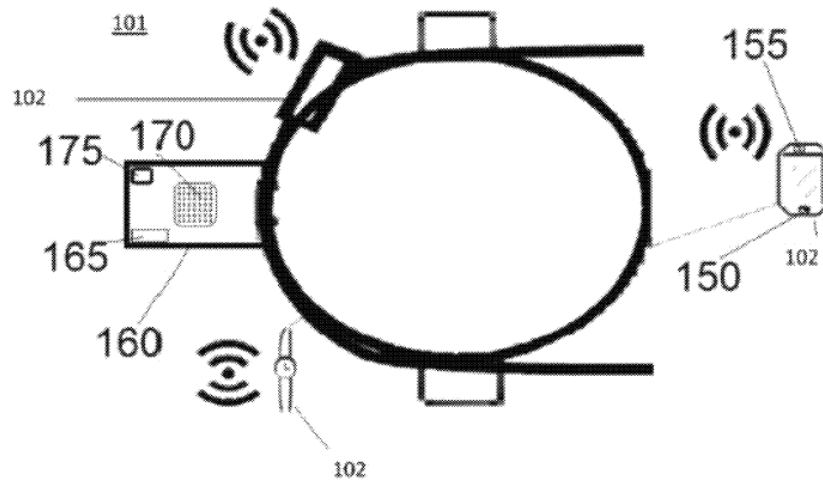


FIG. 1

EX1001, FIG. 1.

28. A computing device within the '016 patent's claimed cluster of at least one computing device "determine[s] whether or not the input signals match a set of predefined thresholds." EX1001, 13:16-17. If a sound sensing mechanism of the respective computing device detects a sensed energy, the device "determines if the predefined threshold ... is breached," such as a frequency or magnitude threshold. EX1001, 13:22-24; 14:16-20. If the threshold is breached, the primary computing device may "communicate its signal measurements to other devices within its cluster and the receiving device will conduct the same audio measurements to confirm the threshold breach." EX1001, 13:25-30. Altering a "dynamic range of the sensed audio... help[s] sound(s) sit consistently in an audio

mix (accomplished by removing sudden peaks).” EX1001, 17:10-16. And doing so also “eliminate[s] any audio in the predetermined hazardous range.” EX1001, 17:16-18.

29. Thus, to address the issues of prior art and improve sound management and manipulation systems, the ’016 patent claims a novel way of controlling and altering sounds from sensed energies detected among a variety of computing devices. Specifically, the challenged independent claims—claims 32 and 39— recite, among other features, “at least one cluster of at least one computing device that senses sound,” wherein the at least one computing device “detect[s] a sensed energy” and “monitor[s] one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds, wherein at least one of the monitored one or more parameters is aggregated over time.” EX1001, claims 32 and 39. The claimed computing device can “vary[] an output of the at least one output device”—as recited in claim 39—or “receive an input from a user for manually adjusting a volume”—as recited in claim 32. The claimed computing device may “determin[e] if at least one of the monitored one or more parameters falls outside of a predetermined threshold,” “alter one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside the predetermined threshold,” and “output[] the one or more sounds on the at least one output device.” EX1001,

claims 32 and 39. The dependent claims of the '016 patent further describe these innovative audio functionalities.

30. Accordingly, the '016 patent describes and claims a novel system that provides audio management and manipulation functions for computing devices and output devices operating within a cluster. EX1001, 17:10-18. This implementation facilitates a personalized system of hearing protection for audio listeners. EX1001, 17:10-18. This audio manipulation and communication was a substantial improvement to the systems existing before the priority date of the '016 patent.

Overview of the Prosecution History of the '016 Patent

31. It is my understanding that the '016 patent received one non-final Office Action in which several claims—none of which are challenged in the instant proceeding—were rejected under 35 U.S.C. § 112(a). EX1004, 188-96. I understand that the challenged claims at issue in this proceeding were not rejected and were deemed to contain allowable subject matter. EX1004, 191. To overcome the § 112(a) rejection, Patent Owner canceled the rejected claims, as well as other claims, to place the respective application in a condition for allowance. EX1004, 214-41.

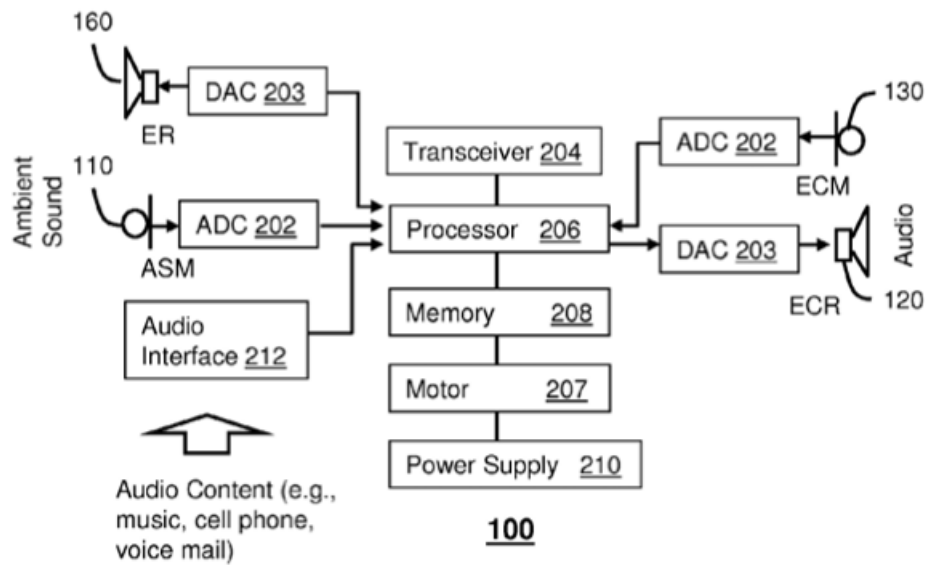
VIII. OVERVIEW OF THE APPLIED REFERENCES

32. I understand that Petitioner's expert, Dr. Kyriakakis, relies on numerous references in his proposed obviousness grounds for the challenged

claims of the '016 patent. Three of those references are particularly relevant to my opinions provided in this Declaration: Goldstein873 (EX1005, hereinafter referred to as “Goldstein”), Newham (EX1006), and Chaudhri (EX1009). I provide brief overviews of these references below.

A. Goldstein

33. Goldstein describes “a method and device for personalized hearing.” EX1005, ¶6. In particular, I understand that Goldstein describes “an earpiece device [including] an Ambient Sound Microphone (ASM) 110 to capture ambient sound, an Ear Canal Receiver (ECR) 120 to deliver audio to an ear canal 140, and an ear canal microphone (ECM) 130 to assess a sound exposure level within the ear canal.” EX1005, ¶24. Goldstein’s earpiece “monitor[s] a sound pressure level both inside and outside an ear canal.” EX1005, ¶25. The earpiece also “enhance[s] spatial and timbral sound quality while maintaining supervision to ensure safe reproduction level” based on the monitored sound pressure levels. EX1005, ¶25. Goldstein’s architecture of the disclosed earpiece is depicted below:



EX1005, FIG. 2.

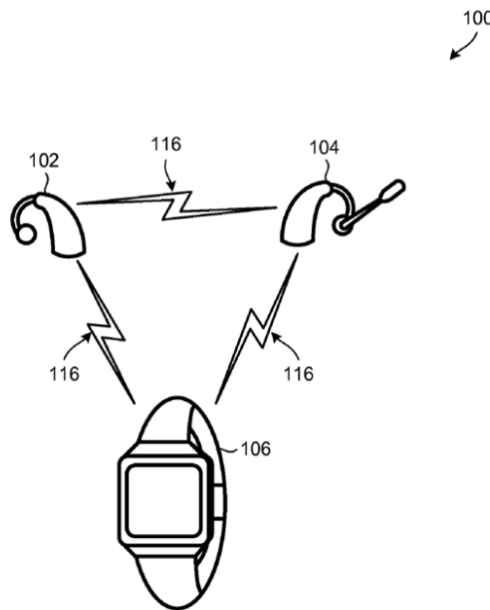
34. I understand that Goldstein’s method “can be implemented in a single earpiece, a pair of earpieces, or headphones.” EX1005, ¶31.

B. Newham

35. Newham describes a system for “balanc[ing] power consumption among wireless devices operating in a master-slave configuration by exchanging master and slave roles in a manner that is less noticeable to a user.” EX1006, ¶3. Newham “establish[es] a first communication link between a first wireless node and a second wireless node.” EX1006, ¶4. I understand that Newham swaps master and slave roles without requiring “that the communication link between the existing master device (e.g., a first earpiece) and the source device (e.g., media player) be terminated.” EX1006, ¶28. Newham’s “composite electronic device 100

may include a first earpiece 102, a second earpiece 104, and a wrist display 106.”

EX1006, ¶41. Goldstein also describes that these components may include wireless links that are “established at the factory so that the user perceives the composite electronic device 100 as a single component.” EX1006, ¶41. Newham’s disclosed system is reproduced below:



EX1006, FIG. 1.

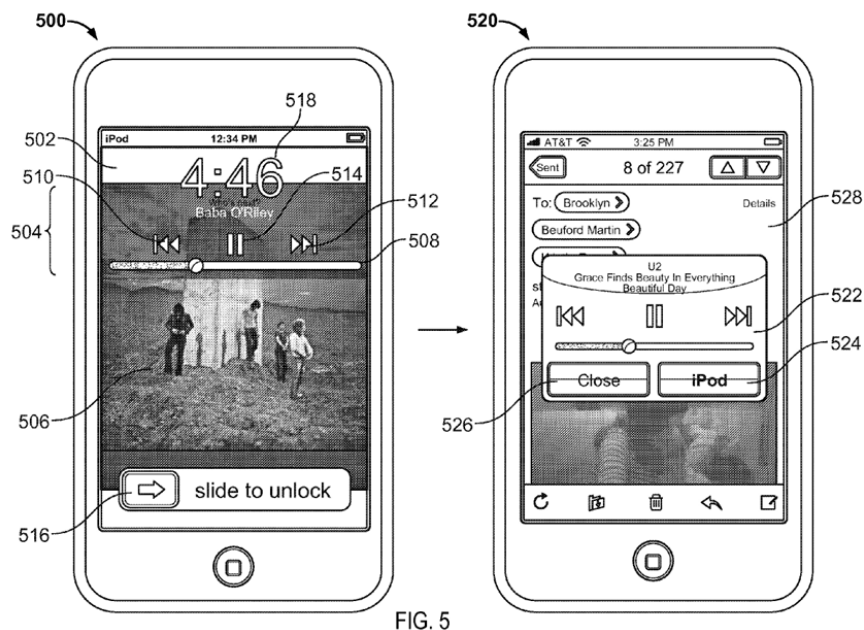
C. Chaudhri

36. Chaudhri describes “an audio file interface” that “display[s] a current view in a user interface of the mobile device.” EX1008, ¶4. I understand Chaudhri’s interface “receiv[es a] first user input requesting that an audio interface be displayed, and display[s] the audio interface as an overlay in the user interface.” EX1008, ¶4. Chaudhri indicates that its interface may reflect a Graphical User

Interface (GUI). The GUI may include a “touch-sensitive display 102 [that] present[s] display objects related to various phone functions.” EX1008, ¶33.

Chaudhri also notes that “the HUD audio interface 504 includes the following user interface elements: a volume slide control 508, a reverse track control 510, a forward track control 512, and a pause/play control 514.” EX1008, ¶74. I understand that a user, using Chaudhri’s touchscreen, “can select and slide an indicator of the volume slide control 508 to change the volume level of the device 100 or 101 for a particular audio file playing on the device.” EX1008, ¶75.

Chaudhri’s touchscreen interface is reproduced below:



EX1008, FIG. 5.

IX. DETAILED DISCUSSION OF OPINIONS

37. For purposes of this Declaration, I have been asked to opine on certain positions taken by Petitioner and Dr. Kyriakakis. That I omit certain claims, claim elements, or presented grounds from my analysis should not be viewed as agreement that any claims or claim elements are obvious.

38. Upon considering the materials listed above and discussed herein, based on my extensive experience and education in the relevant art, in view of my understanding of the governing legal principles and the arguments presented in the Petition, I have formed the following opinions.

A. Dr. Kyriakakis and the Petition fail to establish that Goldstein-Newham teaches the claimed “output device” in both independent claims.

39. Independent claims 32 and 39 recite “*at least one output device*” that is in communication with “*at least one computing device.*” It is my opinion that the Petition relies on a fundamental misunderstanding of Goldstein, conclusory and improper expert testimony from Dr. Kyriakakis, and an insufficient motivation to combine the cited references to support its allegation that Goldstein-Newham teaches this claimed feature. *See* Pet., 18-25; *see also* Pet. 53 (relying solely on the analysis of claim 39 for the “*output device*” recited in claim 32).

40. First, Petitioner asserts, through Dr. Kyriakakis, that a POSITA *would have understood* Goldstein’s disclosure in paragraph 30 “to encompass earpiece

100 being in a master-slave arrangement ... including the other earpiece.” Pet., 18 (citing EX1002, ¶96). I do not agree with this assessment. In my opinion, Petitioner’s obviousness theory for the “*output device*” relies on Goldstein allegedly disclosing a slave earpiece. This includes, as I explain further below, what I believe to be a deficient reason to combine Goldstein-Newham. In my opinion, a POSITA would not have understood Goldstein to disclose earpieces in a master-slave arrangement.

41. Goldstein describes that earpiece 100 can represent “a family of devices” configured in a master-slave arrangement. The family of devices may include “for example, **a mobile device and an earpiece.**” EX1005, ¶30 (emphasis added). Goldstein separately describes its embodiments can be implemented in single earpiece or “a pair of earpieces.” *See e.g.*, EX1005, ¶¶31, 42. Therefore, it is my opinion that Goldstein distinguishes between “a pair of earpieces” and its “family of devices” configured in a master/slave relationship, such as a mobile device and an earpiece. Nowhere does Goldstein disclose an earpiece in a master-slave relationship **with another earpiece.**

42. Second, it is my opinion that the Petition relies on expert testimony and not Goldstein’s teachings themselves to support its deficient mapping. Petitioner’s sole support for its allegation that Goldstein teaches the alleged second “slave” earpiece is a conclusory statement from Dr. Kyriakakis. Dr. Kyriakakis

explains that, in his opinion, “a person of ordinary skill in the art would have understood” Goldstein’s disclosure to be in “a master-slave arrangement” with another earpiece. Pet., 18; EX1002, ¶96. Dr. Kyriakakis (and the Petition) does not actually point to a teaching in Goldstein or provide any corroborating evidence for this assertion. I do not believe Dr. Kyriakakis’s opinion is correct.

43. I believe a POSITA would not have understood Goldstein to disclose earpieces in a master-slave relationship. A master-slave relationship is of a different character than the example earpiece pair relationship. For instance, conventional earpieces using noise suppression technology included each earpiece performing noise analysis functions. *See, e.g.*, EX2007 (describing each earbud of an earbud pair including separate microphones for audio adjustment). Conversely, a master-slave relationship within a family of devices involves a master device communicating with its slaves, while slaves may only communicate with the master. *E.g.*, EX2008, 709. Goldstein does not describe such an arrangement. This is evidenced by Goldstein’s explicit disclosure. Goldstein distinguishes between its family of devices (such as a mobile device acting in a master relationship to communicate sound to a slave earpiece device) and a pair of earpieces. Goldstein indicates that its listening test may be performed by a pair of earpieces, which indicates the earpieces function independently and not in a master-slave arrangement. EX1005, ¶¶30-31. In contrast, a POSITA would have understood

Goldstein's family of devices to indicate that the interaction between the mobile device (e.g., a master) as driving audio content. EX2008, 709.

44. Lastly, I believe Petitioner's flawed analysis of Goldstein tarnishes its reason to combine Goldstein with Newham. Petitioner alleges that because Goldstein "does not focus on the implementation details relating to how the pair of earpieces ... would operate in a master-slave arrangement," a POSITA would have been motivated to look for information on how to implement Goldstein's pair of earpieces in such an arrangement. Pet., 18-19, 23. Petitioner further alleges a POSITA would have had a reasonable expectation of success because both Goldstein and Newham disclose earpiece systems that "operate in a master-slave arrangement." Pet., 24. But, as I describe above, Goldstein does *not* disclose earpieces in a master-slave relationship. Thus, the Petition's entire reason to combine Goldstein with Newham is based on a faulty premise. In my opinion, Petitioner does not provide adequate reasoning why a POSITA would combine Goldstein and Newham or why a system would function successfully after being combined.

45. Because the Petition fails to establish Goldstein discloses an earpiece in a slave relationship—relied upon to meet the claimed "*output device*"—and does not provide a sufficient reason to combine Goldstein with Newham or why the combination would function successfully, it is my opinion that Petitioner fails to

establish independent claims 32 and 39 would have been obvious over Goldstein-Newham.

B. Dr. Kyriakakis and Petitioner's obviousness theory for the claimed sound sensing mechanisms fails

46. Claim elements 39[b][i] and 32[b][i] recite “*a sound sensing mechanism, configured to: detect a sensed energy, wherein the sensed energy comprises one or more sounds; and monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds.*” I believe Petitioner and Dr. Kyriakakis's obviousness theory of these claim elements is fundamentally deficient and fails to meet the provide a reasonable expectation of success needed to invalidate these claim elements. I believe this obviousness theory is deficient because Petitioner improperly attempts to overcome the deficiencies of Goldstein with Goldstein864, which is not included in any of the Grounds, and then wrongly asserts that Goldstein inherently teaches what is described in Goldstein864.

47. I understand from counsel that Petitioner is implicitly relying on an inherency theory to support its obviousness theory because Goldstein does not describe measuring SPL to automatically comprise measuring an amplitude. I understand from counsel that, to support an inherency theory, Petitioner must explain how the missing limitation is necessarily present in the applied art. I believe Petitioner's obviousness theory advances the notion that the SPL formula

in Goldstein⁸⁶⁴ is a function of amplitude and would fundamentally measure the same parameters (e.g., “a reference pressure” and “the root mean squared pressure amplitude in a measured pressure”). Pet., 16-17. However, I do not agree that these parameters are necessarily present in Goldstein or elsewhere. SPL, when measured in decibels, is used to provide a loudness measurement. EX2009, 21-22. Other times, a weighting filter is applied to the SPL—such as A-, B-, and C- weighting—that highlight varying perceptual frequency ranges, which may be relevant to tailor loudness analyses to a particular environment. EX2009, 21-22. For instance, one system may perform calculations using C-weighting and another system may perform calculations using A-weighting. EX2009, 22. These involve measuring and calculating loudness or volume differently, by which SPL dB, dB(A) (*i.e.*, A-weighting), and dB(C) (*i.e.*, C-Weighting) can have differing meanings and values. EX2009, 21-22, 26. Petitioner and Dr. Kyriakakis are wrong in assuming that Goldstein must necessarily measure SPL in the same manner as prescribed by the SPL formula included in Goldstein⁸⁶⁴. Indeed, Goldstein⁸⁶⁴ explicitly describes that sound pressure level may be calculated as a weighted value “to better emulate the sound as received at the ear” and describes a formula, different than that set forth in Equation 1, to calculate sound pressure level using weighted values. EX1010, 12:45-58. As I explain, a POSITA would have understood there are numerous ways loudness can be presented in different manners, by which SPL dB,

dB(A) (*i.e.* A-weighting), and dB(C) (*i.e.* C-Weighting) may reflect different meanings based on the loudness analysis that is performed. And based on this, I believe that Goldstein does not necessarily measure SPL using the formula set forth in Equation 1 of Goldstein⁸⁶⁴. Thus, I do not agree with Petitioner's obviousness theory for the claimed sound sensing mechanism.

48. For these reasons, I do not believe Petitioner establishes independent claims 32 and 39 would have been obvious in view of Goldstein-Newham.

C. Dr. Kyriakakis and Petitioner fail to show how the combination of Goldstein-Newham “vary an output” of the “output device.”

49. Independent claims 39 and 32 recite “*varying an output of the at least one output device.*” I understand Petitioner previously relies on Newham's slave earpiece to teach the claimed “output device” limitation. Pet., 21, 28 (relying on the second earpiece (slave earpiece) as the output device outputting audio received from the master earpiece). In my opinion, Petitioner and Dr. Kyriakakis fail to show that Goldstein-Newham teaches *varying an output* of the slave earpiece.

50. I understand Petitioner alleges Goldstein's earpiece “selectively filter[s] out the measured noise from the ambient sound” and “mix[es] the audio content with the filtered sound to produce filtered audio.” Pet, 29 (quoting EX1005, ¶43). Petitioner also alleges that Goldstein-Newham teaches the claimed varying because “the first earpiece 100 is configured to . . . adjust a level of filtered ambient sound played by the second earpiece.” Pet., 30. I believe Petitioner relies

on a conclusory (and incorrect) statement from Dr. Kyriakakis that a “POSITA would therefore have recognized that the processor 206 of the first earpiece 100” would adjust a level of filtered sound provided to the second earpiece.” Pet., 30. I believe the correct interpretation of Newham is that the first earpiece in Newham’s master-slave arrangement merely operates as a middleman device that relays audio originating from a third device. *E.g.*, EX1006, ¶53. Indeed, systems existing prior to the filing date of the ’016 patent merely described transmitting audio originating from the mobile device to the first earpiece, which is transmitted to a second earpiece. *E.g.*, EX2010, 21-24 (describing such systems existing by the priority date of the ’016 patent). These systems, such as Newham, performed noise cancellation and adjustment for each earbud because each earbud needed to account for both of the user’s ear canals. *See e.g.*, EX2010, 24-26.

51. Even so, based on Petitioner’s prior mapping of the *second* (slave) earpiece to the claimed output device (Pet., 21, 28), I believe Petitioner’s obviousness theory fails. Petitioner, and Dr. Kyriakakis, focus on varying an output from the first earpiece and do not explain how the combination teaches varying the output from the second earpiece. Petitioner acknowledges that the second earpiece does not adjust audio in the ear canal. Pet., 30 (“a second earpiece 100 operating as a slave device would not . . . adjust the audio in the ear canal”). This is consistent with my analysis above because each earbud needed to account for both of the

user's ear canals. EX2010, 24-26. I believe Petitioner, and Dr. Kyriakakis, fail to explain how this claim element would have been obvious to a POSITA given the technical systems existing at the time of the '016 patent's priority date.

52. Accordingly, in my opinion, Petitioner fails to show Goldstein-Newham discloses varying an output of an output device.

D. Dr. Kyriakakis and Petitioner's reading of Goldstein-Newham is flawed because the combination does not establish the combination teaches the claimed altering one or more sounds.

53. Claim element 39[e][ii] recites, "*if at least one of the monitored one or more parameters falls outside of the predetermined threshold, altering one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside of the predetermined threshold.*" Claim elements 32[e][ii]-[iii] recite similar features. It is my opinion that the Goldstein-Newham combination teaches *altering one or more sounds* based on a determination that "*one of the monitored one or more parameters falls outside of the predetermined threshold.*"

54. I believe Petitioner's mapping of the applied references to the claims changes for various claim elements. I also believe that Petitioner and Dr. Kyriakakis fail to show that the Goldstein-Newham combination teaches altering one or more sounds based on a determination that "one of the monitored one or more parameters falls outside of the predetermined threshold."

55. *First*, in my opinion, Petitioner’s characterization of Goldstein is incorrect and inconsistent. Petitioner previously mapped the “*monitored one or more parameters*” to be the “amplitude of the one or more sounds.” Pet, 17. Petitioner alleges that if the SPL (incorrectly mapped to the amplitude for reasons I noted above) exceeds a threshold in Goldstein’s system, it is adjusted to be below Effective Quiet level. Pet., 35-36; *see also* Pet., 60 (adopting the prior analysis of claim element 39[e][ii] in the Petition). However, for claim elements 32[e][iii] and 39[e][ii], I believe Petitioner’s application of Goldstein to the challenged claims suddenly changes. Petitioner and Dr. Kyriakakis allege that “responsive to determining that a captured amplitude of a sound exceeds a predetermined value ... that causes a corresponding SPL to exceed the Effective Quiet level **and** that an SPL Dose threshold has been exceeded, adjusting” an amplitude of the filtered sound. Pet., 36 (emphasis added). In other words, I understand Petitioner and Dr. Kyriakakis to change their mapping of the “threshold” to two distinct thresholds that requires both the SPL to exceed the Effective Quality level **and** the SPL Dose threshold to be exceeded before any action is taken. SPL and SPL Dosage are two different measurements, as Goldstein describes. EX1005, ¶¶44-45. Accordingly, I believe Petitioner and Dr. Kyriakakis fail to show this claim element as obvious.

56. *Second*, as Petitioner notes, any adjustment of an SPL in Goldstein relies on “whether an SPL Dose threshold is exceeded.” Pet., 35; *see also* EX1005,

¶49, FIG. 6. I believe Petitioner and Dr. Kyriakakis's own analysis indicates that Goldstein-Newham does not "alter[] one or more sounds" based on a determination that an SPL exceeds an Effective Quiet level. Pet., 36. Goldstein notes that, for any adjustments to be made in Goldstein's system, the SPL Dose (a user's cumulative exposure to sound) must be exceeded. EX1005, ¶49. In my opinion, a POSITA would have understood this to be entirely different from a measured amplitude. SPL Dose relates to a percentage of the maximum permissible daily exposure to sound. EX2011, 465. Indeed, SPL Dose reflects how long an individual has experienced particular sounds and any adjustments are made based on a time of exposure, not based on an amplitude threshold being exceeded. EX2011, 465-66. Furthermore, Goldstein describes that any adjustment to a level of filtered audio is predicated on the SPL Dose exceeding a threshold, not the SPL. *See* EX1005, FIG. 6 (reproduced below)

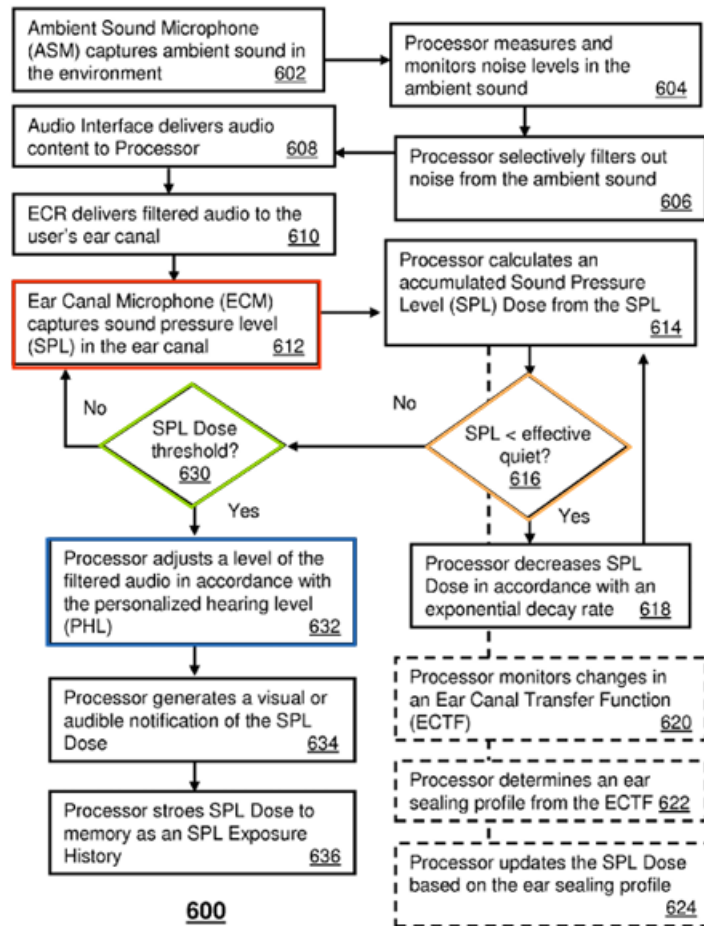


FIG. 6

EX1005, FIG. 6 (annotated by Patent Owner).

57. Goldstein compares an SPL to an Effective Quiet level (orange) and any adjustment to filtered audio (blue) is determined based on the SPL Dose threshold being exceeded (green). As shown in Figure 6 of Goldstein, an SPL could exceed the Effective Quiet level (orange) but remain unadjusted (red) when the SPL Dose threshold is not exceeded (green). Thus, Goldstein teaches that filtered audio is only adjusted if the SPL dose—which is not mapped to the claimed one or more monitored parameters—exceeds a threshold. Pet., 15.

58. Additionally, in my opinion, the SPL Dose cannot teach the claimed monitored “one or more parameters” (based on which the sounds are altered). SPL Dose is a percentage measurement of a time-weighted average for sound pressure exposure. *See* EX1005, ¶45; *see also* EX2012, Abstract (describing that “noise dosage is a function of the level of an acoustic signal and the length of exposure to it”). Thus, in my opinion, the SPL Dose cannot meet the claimed feature that the monitored one or more parameters are “an amplitude” or “a frequency” (32[b][i]/39[b][i]). EX1005, ¶45 (describing SPL Dose as a percentage value indicative of a length of exposure to sound).

59. Thus, in my opinion, Petitioner does not establish these claim elements would have been obvious because Petitioner applies an incorrect reading of Goldstein and fails to show Goldstein discloses “*altering one or more of the one or more sounds*” in the manner prescribed by the claims.

E. Dr. Kyriakakis and Petitioner’s obviousness theory for claim 36 does not teach or suggest an “Effective Quiet level” being a “predetermined threshold ... determined to pose a risk of harm to a user’s hearing capabilities.”

60. Dependent claim 36 recites “*wherein the predetermined threshold equates to a frequency or an amplitude determined to pose a risk of harm to a user’s hearing capabilities.*” In my opinion, Petitioner’s flawed analysis of the independent claims tarnishes its obviousness theory for claim 36. *See e.g.*, Pet., 14-17, 36-38 (Petitioner’s mapping of the claimed predetermined threshold).

61. As discussed above, I believe Petitioner’s flawed analysis relies on **both** the SPL (the alleged monitored parameter) and the SPL dose (a percentage) deviating from respective thresholds. *See supra* Section IX.D; Pet. 14-17. Also, as discussed, Goldstein requires that two respective thresholds for the SPL and SPL Dose—which are two distinct measurements—must be exceeded to adjust any audio delivered to a user. EX1005, ¶¶43, 49. Thus, in my opinion, the Effective Quiet level cannot itself be the alleged predetermined threshold because such a parameter can be exceeded without resulting in an adjustment to the output of the output device. Petitioner does not map SPL Dose to the monitored one or more parameters recited in the claims, nor can it because the SPL Dose results in a percentage value of cumulative exposure over time. EX1005, ¶45; *see also* EX2012, Abstract (describing that “noise dosage is a function of the level of an acoustic signal and the length of exposure to it”). Accordingly, I believe Petitioner fails to show claim 36 would have been obvious.

62. Furthermore, I believe Petitioner’s obviousness theory of claim 36 relies on inaccurate and conclusory statements from Dr. Kyriakakis. Dr. Kyriakakis opines “[a] POSITA **would thus have understood** the Effective Quiet level to be a predetermined threshold for which exposure to sound levels exceeding it may result in permanent hearing loss.” Pet., 65-66; EX1002, ¶¶210-12 (emphasis added). However, I disagree with Dr. Kyriakakis because a POSITA would not

have understood the Effective Quiet level to be a predetermined threshold for which exposure to sound levels exceeding it may result in permanent hearing loss. There are many possible measurements to identify sound exposure leading to hearing loss, many of which measure sound exposure levels over a period of time or threshold levels distinct from an Effective Quiet level. *See generally* EX2013; EX2014; EX2015 (respectively describing applications of distinct thresholds to approximate hearing loss). Thus, I believe a POSITA would not have understood an Effective Quiet level, by itself, to be a predetermined threshold for which exposure to sound levels exceeding it may result in permanent hearing loss.

63. I believe Petitioner's analysis does not fully and clearly explain how the combination of Goldstein-Newham-Chaudhri renders obvious claim 36. Therefore, in my opinion, the Petitioner and Dr. Kyriakakis fail to show this claim would have been obvious.

F. Dr. Kyriakakis and Petitioner fail to establish how a POSITA would have understood Goldstein's earpiece may be used as a smart device.

64. Claim 43 recites "*wherein at least one output device comprises a smart speaker.*" Petitioner and Dr. Kyriakakis acknowledge that Goldstein does not disclose this functionality. *See* Pet., 41-44. Instead, both Petitioner and Dr. Kyriakakis merely provide a high level overview of Goldstein's generic structural components of its earpiece, as well as Goldstein⁸⁶⁴, to fill in the gaps of

Goldstein. Pet., 41-44.

65. Petitioner and Dr. Kyriakakis allege Goldstein's earpiece may be used as a "smart device." Pet., 44. However, both rely on Goldstein864, a reference I understand is not included in the Grounds, as allegedly disclosing such functionality. Pet., 44 (citing to Goldstein864, 8:30-38 as opposed to Goldstein for this argument). I believe a POSITA would not understand Goldstein as inherently disclosing "a smart speaker." By the priority date of the '016 patent, smart speakers were growing in popularity, and many speakers used different technical schemes to perform specific functions. *See, e.g.*, EX2016, 9218-26 (describing how many popular smart speakers operated with distinct algorithmic approaches in retrospect).

66. In my opinion, based on my counsel's explanation of the requirements for inherency, Petitioner does not explain why the teachings of Goldstein864 are *necessarily present* in Goldstein and I believe that they are not for the reasons I explain below.

67. I believe a POSITA would not have understood Goldstein to inherently include a "smart speaker." The Goldstein references are directed towards different implementations, one for personalized hearing (Goldstein) and another for ear-health monitoring (Goldstein864). *See* EX1005, ¶2; EX1010, 1:12-15. Because many smart devices (such as speakers) used different technical

schemes to perform specific functions, a POSITA would not have understood that Goldstein864's teachings are *necessarily present* in Goldstein. *See, e.g.*, EX2016 (describing how many smart systems implement distinct algorithmic approaches to speech processing for different implementation types). Indeed, systems similar to Goldstein and Goldstein864, respectively, involved different implementations. *See* EX2017 (describing a system for personalizing hearing profiles to mitigate environmental noise exposure, similar to Goldstein); EX2018 (describing an experimental system for monitoring in-ear health, similar to Goldstein864). Goldstein would thus require additional technical schemas to perform operations as a smart device as compared to Goldstein864. Accordingly, a POSITA would not have understood Goldstein to inherently include a "smart speaker," as Dr. Kyriakakis alleges.

68. Therefore, I believe Petitioner and Dr. Kyriakakis fail to show this claim would have been obvious.

G. Dr. Kyriakakis and Petitioner fail to show how SPL Dose is an aggregate of an amplitude.

69. Claim 32 recites "*wherein at least one of the monitored one or more parameters is aggregated over time.*" EX1001, Claim 32. Petitioner and Dr. Kyriakakis acknowledge that Goldstein does not explicitly disclose this feature. Instead, both allege "[a] POSITA would have understood that SPL Dose is a value derived by aggregating SPL values over time, and thus an aggregate of

amplitudes.” Pet., 53. I do not agree with this assessment.

70. Goldstein describes an SPL Dose to be a “**percentage of a maximum time-weighted** average for sound pressure level exposure.” EX1005, ¶45 (emphasis added). This resembles “an individual's cumulative exposure to sound pressure levels over time.” EX1005, ¶45. As discussed above, in my opinion, Goldstein does not disclose SPL as an amplitude. *See* Section IX.B. Even so, I believe Petitioner and Dr. Kyriakakis fail to show how a percentage value (i.e., SPL Dose) is an “*aggregate[]*” of a monitored parameter (e.g., amplitude).

71. In particular, I believe a POSITA would not have understood that SPL Dose is a value derived by aggregating amplitude values over time. SPL Dose is merely a percentage of time by which a person is exposed to harmful noises. For instance, SPL Dosage may reflect a percentage of time by which an individual is exposed to a particular sound level over a period of time. EX2019. Deriving a time-weighted average is of a different character than “aggregating” any monitored parameter, as such operations include additional considerations such as a control time, a reference duration, and weighted exposure values. EX2019. Dr. Kyriakakis’s explanation that a POSITA would have understood SPL Dose is an aggregate of an amplitude is not consistent with its technical implementation in sound analysis functions. *See* EX2019.

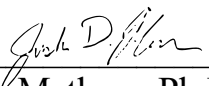
72. Accordingly, I believe Petitioner fails to show this element of claim 32 would have been obvious.

X. CONCLUSION

73. In signing this Declaration, I recognize that the Declaration will be filed as evidence in an *inter partes* review before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I will appear for cross-examination within the United States during the time allotted.

74. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

75. Executed on this 19th day of February, 2026, in Raleigh, North Carolina.



Justin D. Mathew, Ph.D.